

wire by which the power was conveyed from the negative end of the battery. Lead, silver, copper, and iron, were successively employed; and it was by means of the last that the most distinct results were obtained.

When an iron wire, one seventieth of an inch in diameter, was made the conductor on the negative side, and brought into contact with moistened barytes or strontites, lime or magnesia, alumine or silex, the globule formed by fusion at the end of the wire appeared in each case to be alloyed with something capable of acting upon water; but those last named had, in succession, less action than the preceding.

The author had not himself used mercury as a means of obtaining the bases in a state of alloy till informed by a letter from Professor Berzelius of Stockholm, who has used it with success for the decomposition of lime and barytes. And Mr. Davy has found it to succeed equally with strontites and magnesia. And although mercury alone failed of effecting the decomposition of alumine and silex, yet when an alloy of mercury and potassium was made the medium of communication even with these bodies, they each appeared to be decomposed by assistance of the affinity of potassium for their bases.

The author also informs us of his success in repeating an experiment of Professor Berzelius and Mr. Pontin, on the decomposition of ammonia: a globule of mercury being inserted in a small cavity made in a piece of carbonate or muriate of ammonia slightly moistened, they are placed together on a plate of platina positively electrified, and the wire from the negative end of the battery is applied to the mercury. The globule soon increases very considerably in bulk, and becomes converted into a soft amalgam, which absorbs oxygen from the atmosphere, or decomposes water into which it is thrown, and forms ammonia, while the globule gradually recovers its fluidity, and is reduced to its original size before the experiment.

The Croonian Lecture. On the Functions of the Heart and Arteries.
By Thomas Young, M.D. For. Sec. R.S. Read November 10,
1808. [*Phil. Trans.* 1809, p. 1.]

Since the degree and manner in which the circulation of the blood depends upon the muscular and elastic powers of the heart and arteries are questions belonging to the most refined departments of hydraulics, the author has already submitted to the Society those general principles upon which he designs, in the present lecture, 1st, to inquire what would be the nature of the circulation if the vessels were as inelastic as glass or bone; 2ndly, in what manner the pulse would be transmitted if the tubes were merely elastic; 3rdly, what actions may be ascribed to their muscular coats; and, lastly, what disturbances are occasioned in different kinds of fevers and inflammations.

In order to determine the velocity of the blood in different parts, it is necessary to estimate the pressure by which it is urged forward, and the resistance opposed to its motion. From the experiments of

Hales, the *pressure* may be considered as equivalent to a column of seven feet. In order to calculate the *resistance*, the author employs the theorems contained in his former communication, and adopts the measurements of Keill and others, for the diameters of the aorta, and of its successive subdivisions. The quantity of blood in the arteries is estimated at nine or ten pounds; its velocity in the aorta about eight inches and a half in a second; while that in the capillary arteries is about $\frac{1}{9}$ rd of an inch in a second (the diameter of these vessels being about $\frac{1}{1100}$ th of an inch). The resistance that would be opposed to *water* circulating under the same circumstances is calculated to be equivalent to a pressure of a column of twenty inches; but the resistance to the motion of the *blood* is supposed in consequence of its viscosity to be about four times as great, and is consequently stated as eighty inches.

The effects of curvature in increasing the resistance are not neglected, but they form a very small part, in comparison to the difference that would arise from assuming different dimensions for the arterial system; or different allowance for the resistance of vessels that are too small for direct experiment, or a different ratio for the assumed effect of viscosity.

The author next examines the nature and velocity of the propagation of the pulse, which he considers analogous to the motion and waves on the surface of water, or of sound transmitted through the air; the elasticity of the arteries being, in this case, substituted for the elasticity of the fluid. Since the blood in the human arteries is subjected to a pressure, which is measured by a column of about seven feet and a half, the velocity with which the impulse is transmitted will be about fifteen feet and a half in a second; but as the progressive motion of the blood itself is about eight inches in the same time, the aggregate velocity of a pulsation is considered as sixteen feet in a second.

The greatest velocity of the blood during the contraction of the heart being about one eighth part of that quantity, the area of the artery must be proportionally dilated during its passage, and the diameter must increase in the ratio of fifteen to sixteen.

The force of the heart necessary to occasion this distension, must be proportionally greater than the average, and must be equal to a column of 101 inches, which agrees extremely well with an experiment of Hales, on the ascent of blood in a tube connected with the artery of a horse.

The author acknowledges, however, that though the calculations agree perfectly with each other, and with experiments on the power of the heart, and affections of the smaller arteries, yet they do not correspond with the apparent alteration in the diameter of an artery exposed to view; and he infers that the velocity of the pulse in the larger arteries, is really much more considerable than has been stated.

With respect to the functions of the muscular fibres of the arteries, Dr. Young apprehends that it will appear demonstrable that they are much less concerned in the motion of the blood than is almost uni-

versally believed; and though a mola has sometimes been found in the uterus totally destitute of heart, and in which the blood must have circulated, in its usual course, through the arteries and veins, it cannot be known that there was any alternate pulsation; and, even if there was any pulsation, it must have arisen from preternatural power in the arteries, and the resistance in the extreme vessels must have been preternaturally small.

The service which the author imagines is performed by the muscular coats of arteries, is that of adapting their capacities to the varying quantity of the blood contained in them.

According to this statement, the qualities of the pulse, as discernible to the touch, are ascribed almost entirely to the action of the heart.

The duration from the natural state may consist either in a change of the heart or of the capacity of the smaller arteries. The quantity of blood transmitted may also remain the same, or be diminished, or be increased. When it remains the same, the change cannot be very material, and is not likely to lead to any disease of the vital functions. When the quantity transmitted is smaller than in health, the arteries must become contracted, and the veins distended. The pulse must be small and weak, until the blood accumulated in the veins stimulates the heart to greater action. From the vigour acquired during the former remission of its exertion, the pulse becomes full and strong, a greater quantity of blood being transmitted than in health, as seems to occur in the hot fit of fevers.

A relaxation of the extreme arteries may, at the same time, suffer the blood to pass more easily into the veins; but such a relaxation may be carried to excess, and the arteries be thereby emptied; so that the pulse becomes small and weak, and the heart exhausted by fruitless efforts to restore the equilibrium, as appears to occur in typhus.

As *general* derangements of the circulation appear to be concerned in different kinds of fever, so *partial* ones have a similar relation to local inflammations. The most obvious changes arise from partial dilatations or contractions of the capillary arteries. Distension will be accompanied with redness, pain, and heat. But it is possible that another species of inflammation may also arise from an *obstruction* of the extreme capillary arteries; so that the small branches are subjected to a pressure many times greater than that which they are intended to withstand in their natural state, and the consequent distension will be accompanied with redness and pain.

Besides these general illustrations of the nature of fevers and inflammations, the author is of opinion that the same theory may be of use in explaining the operation of remedies employed for relieving them, more especially (in the different modes of letting blood), the more speedy and effectual relief from opening an artery than a vein, and the great benefit often derived from the more practicable expedient of withdrawing a small quantity of blood from the immediate neighbourhood of the part affected, by cupping or by leeches.